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Functionally Based Core Competencies and Competitive Advantage in the Heating, Ventilation, and Air Conditioning Sector: A Case Study Using the DEMATEL Method

Mohammadreza Boroomand¹ | Eren Durmuş-Özdemir^{2*}

1. Department of Business Administration, Institute of Social Sciences, Akdeniz University, Antalya, Türkiye. Email: mboroomand70@gmail.com

2. Corresponding Author, Department of Business Administration, Faculty of Economics and Administrative Sciences, Akdeniz University, Antalya, Türkiye. Email: edurmus@akdeniz.edu.tr

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ABSTRACT

This study investigates the critical role of functionally based core competencies in sustaining performance and competitiveness within the heating, ventilation, and air conditioning sector, with a focus on a leading Turkish firm. While technological advancements and regulatory changes have driven industry transformation, the organizational competencies required to maintain a competitive edge remain underexplored. Using the DEMATEL method, this research identifies and prioritizes key functional competencies, emphasizing the strategic importance of customer-oriented marketing and sales strategies in responding to market demands and sustaining competitive advantage. The findings highlight the interplay between technological innovation, cross-functional collaboration, and dynamic capabilities as drivers of long-term success. Although the study provides valuable insights, its focus on a single firm limits its generalizability, indicating the need for broader, multi-firm research. By offering a framework to understand and leverage core competencies, this study contributes to both academic knowledge and practical applications in navigating the evolving heating, ventilation, and air conditioning market.

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1. Introduction

This study underscores the critical importance of functionally based core competencies in achieving sustainable performance and competitiveness within the heating, ventilation, and air conditioning (HVAC) sector. HVAC systems are integral to maintaining indoor environmental quality in various building types. According to the U.S. Environmental Protection Agency (EPA), the primary objectives of an HVAC system are to ensure good indoor air quality through adequate ventilation and filtration, and to provide thermal comfort (EPA, 2023). Technically, HVAC systems are composed of three primary components that work together to regulate indoor environments. The first component, heating systems, includes equipment such as furnaces and boilers, which are designed to generate heat and maintain comfortable indoor temperatures during colder periods. Ventilation systems, on the other hand, are responsible for exchanging indoor and outdoor air. By removing indoor pollutants and introducing fresh air, these systems play a crucial role in maintaining indoor air quality (EPA, 1990). Lastly, air conditioning systems manage cooling and humidity levels within a building, ensuring occupant comfort during warmer periods.

The significance of HVAC systems extends beyond comfort, as they have a substantial impact on human health and productivity (Bluyssen, 2014). For instance, inadequate ventilation and temperature regulation in office buildings can negatively affect employee performance and well-being (Wyon, 2004). Research on indoor air quality (IAQ) has highlighted the critical role of HVAC systems in preventing respiratory illnesses and improving productivity (Godish, 2000; Sundell, 2004). Modern systems increasingly incorporate advanced controls and sensors to optimize performance and energy efficiency, as emphasized by the ASHRAE (2023). In summary, HVAC systems are essential for regulating indoor environments by providing heating, cooling, and ventilation, ensuring comfort and air quality across residential, commercial, and industrial buildings. Despite extensive documentation of technological advancements, the broader role of organizational competencies in sustaining success in this sector remains underexplored (Janda, 2011).

Driven by demographic shifts, urbanization, and increasing reliance on air conditioning systems across residential, commercial, and industrial markets, the HVAC sector has undergone significant growth and transformation. At the same time, it faces dynamic challenges stemming from technological, regulatory, and environmental shifts, highlighting the critical need to explore the organizational competencies that underpin sustained success. Global climate change and rising temperatures have further fueled demand for air conditioning. In developing countries, economic growth and improving living standards have accelerated the adoption of air conditioning (Ürge-Vorsatz et al., 2012). Moreover, the increasing demand for energy-efficient solutions and the integration of advanced technologies—such as smart thermostats, AI-driven systems, and environmentally friendly innovations—have transformed the sector. Consequently, technological advancement, once a competitive advantage, has now become a requirement for survival in this competitive market. To thrive in this evolving landscape, firms must go beyond technology by adopting customer-oriented strategies and embracing principles of sustainability (Elkington, 1997).

The HVAC sector has been selected for this study due to its critical role in addressing global sustainability challenges and its dynamic market conditions, which demand innovative organizational strategies. Focusing on a leading Turkish firm provides a unique perspective on how firms in emerging economies adapt to rapidly evolving global and local market requirements. While the literature emphasizes innovation and efficiency, little attention has been given to how organizational competencies drive success in this dynamic sector, particularly in emerging economies. The heightened competition in the HVAC market stems from factors such as increasing energy costs, growing environmental concerns, and stringent global energy efficiency regulations. Rising energy costs are pushing consumers towards investing in more energy-efficient HVAC systems, prompting companies to develop innovative and cost-effective solutions. Previous studies have largely focused on product innovation and energy efficiency (Pérez-Lombard et al., 2008), leaving a critical gap in understanding the organizational competencies required for long-term competitiveness in the HVAC market. This study aims to address the existing gaps in understanding why organizational competencies are critical in the HVAC sector. This research addresses this underexplored area by analyzing key functional competencies within a leading Turkish HVAC firm, offering practical insights into strategies for success in a highly complex and evolving industry.

The drive for continuous innovation, particularly in green technologies and reducing greenhouse gas emissions (IPCC, 2021), has raised the expectations for HVAC firms. Consumer demand for energy-efficient and environmentally friendly products has prompted companies to invest heavily in research and development (R&D). Such investments are essential not only for regulatory compliance but also to meet evolving consumer expectations. As Porter (1985) argues, competitive advantage often arises from innovation and differentiation, both of which necessitate ongoing R&D efforts. The global shift towards sustainability has created a market environment where only the most innovative and adaptable firms can succeed (Hart, 1995). For example, integrating renewable energy sources, such as solar thermal and geothermal systems, into HVAC products reduces energy consumption and enhances market reputation. However, the possession of advanced technologies and skilled personnel is insufficient in a dynamic industry such as HVAC. Firms must also cultivate dynamic capabilities—the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997). Such capabilities are critical for adapting to market changes and sustaining a competitive edge.

This study aims to identify the essential functionally based core competencies required for firms in the HVAC sector to sustain performance and competitiveness amid evolving market conditions. The motivation behind this study is twofold. First, it aims to address knowledge gaps in the HVAC sector. While technological advancements and regulatory changes are well-documented, the specific competencies that enable firms to maintain a competitive edge remain understudied. Understanding the interplay of these competencies is crucial for sustaining competitive advantage (Porter, 1985; Hart, 1995). Although core competencies have been extensively studied in sectors such as automotive (Prahalad & Hamel, 1990) and technology (Dosi et al., 2000), the HVAC industry has received limited academic attention. This study seeks to fill that gap by analyzing core competencies within a leading Turkish company, known for its sustainable performance practices. Second, the study focuses on navigating the increasing complexity of the HVAC market. This market is characterized by intertwined customer-oriented strategies, technological innovation, and regulatory compliance, all of which necessitate a deeper understanding of organizational capabilities. The HVAC sector serves as a vital contributor to global energy consumption and sustainability efforts. This study's focus on organizational competencies provides both academic and practical insights into navigating challenges within this evolving sector.

By applying the DEMATEL method, this research prioritizes the functional competencies that are most critical for firms' long-term competitiveness. The application of the DEMATEL method not only provides a systematic approach to evaluating interdependencies among competencies but also offers a novel framework for understanding organizational strategies within a dynamic and evolving industry. This is one of the first studies to apply DEMATEL in the HVAC context, making a unique contribution to both academia and industry.

In conclusion, this study seeks to advance understanding of the functionally based core competencies that enable firms in the HVAC sector to navigate evolving challenges and maintain sustainable performance. By focusing on a leading Turkish firm, it provides a detailed analysis of organizational strategies that drive success in a highly competitive and rapidly changing market.

2. Theoretical Background

In recent years, the HVAC industry has gained significant prominence globally, driven by demographic shifts, urbanization, and an increased reliance on air conditioning systems across residential, commercial, and industrial sectors. This prominence has been further amplified by the rising demand for energy-efficient products and the integration of advanced technologies, such as smart thermostats and AI-driven systems (MarketsandMarkets, 2023; Grand View Research, 2023). These innovations not only align with consumer preferences but also comply with stringent global energy efficiency regulations, making technological advancements a necessity for survival rather than a mere competitive advantage.

The rapid growth of the HVAC sector has intensified competition within the industry. As energy efficiency becomes a critical factor for both consumers and regulators, HVAC companies are compelled to innovate continuously and enhance their product offerings. The push for green technologies and reductions in greenhouse gas emissions has heightened the expectations, requiring

firms to remain at the forefront of technological advancements. Regulatory frameworks, such as the European Union's Ecodesign and Energy Labeling Regulations and the U.S. Department of Energy's Appliance and Equipment Standards Program, have further elevated competition by establishing higher benchmarks for product performance and sustainability (European Commission, 2023; U.S. Department of Energy, 2020).

Several factors contribute to the increasing competitiveness of the HVAC sector. First, the growing consumer demand for energy-efficient and environmentally friendly products has driven companies to invest heavily in R&D. This investment is essential for developing innovative technologies that meet evolving regulatory standards and satisfy consumer expectations (Tosin et al., 2020; Javier et al., 2023). Second, the global shift towards sustainable practices has created a market where only the most innovative and adaptable firms can thrive. Companies that fail to innovate risk obsolescence in an industry where rapid technological advancements are reshaping the competitive landscape. For example, integrating renewable energy sources and smart control systems into air conditioning units not only reduces energy consumption and carbon emissions but also enhances a firm's market position and reputation (Tosin et al., 2020). Additionally, evaluating the economic benefits of renewing air conditioning systems highlights the need for facility managers to optimize resource allocation, ensuring that investments in new technologies yield competitive advantages (Akira, 2021). Adopting advanced air conditioning technologies and practices improves operational efficiency, aligns with growing consumer preferences for sustainability, and ultimately boosts market competitiveness (Javier et al., 2023).

In such a competitive environment, resources such as cutting-edge technologies, skilled personnel, and robust R&D capabilities are more critical than ever. However, merely possessing these resources is insufficient in the dynamic HVAC industry. Companies must also develop dynamic capabilities, which involve the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997). Research has demonstrated that dynamic capabilities enhance core competencies, enabling firms to innovate and respond to market demands more effectively (Cegliński, 2020, 2023). These capabilities are essential for HVAC firms to remain competitive in an industry subject to frequent technological and regulatory changes.

Recent trends underscore that adopting smart and environmentally friendly HVAC systems is no longer optional but a necessity for maintaining competitiveness (HVAC Informed, 2023). Moreover, the industry's rapid growth—projected to reach \$202.4 billion by 2028—highlights the importance of cultivating robust resources and dynamically adjusting strategies to adapt to market changes (Grand View Research, 2023). This context illustrates why the sector's growth and increasing competitiveness necessitate a dual focus on resource management and dynamic capabilities. Firms that effectively manage resources while aligning with external environmental changes are better positioned to thrive in the global HVAC market. The interplay between core competencies and adaptability ensures that companies not only survive but also excel in an increasingly competitive environment.

In 2023, the Turkish HVAC sector demonstrated significant growth, aligning closely with global trends. Globally, energy efficiency and environmental sustainability have become primary focal points for the industry, particularly in the European Union. For example, the European Union's Ecodesign and Energy Labeling Regulations mandate improvements in product performance while reducing carbon emissions (European Commission, 2023). Similarly, in North America, the U.S. Department of Energy's Appliance and Equipment Standards Program has guided the industry toward limiting energy consumption (U.S. Department of Energy, 2020). Turkey has also adopted energy-efficient technologies in parallel with these global trends. According to data from the Turkish HVAC&R Exporters Association (İSİB), the Turkish HVAC sector increased exports by 7.3% in 2023, reaching \$7.2 billion. This achievement reflects Turkey's alignment with global energy efficiency goals and its capacity to meet international market demands (Sogutma Donyasi, 2024). Turkey's success in this context is attributable not only to national advancements but also to its ability to comply with global regulations and demands. Turkey's strategic geographical location and expertise in producing energy-efficient products have further strengthened its competitive position in the European and Middle Eastern markets.

In the first quarter of 2023, the Turkish HVAC sector reached an all-time high export volume of \$671 million in March, with a total export volume of \$1.757 billion by the end of the quarter,

reflecting a 9.1% increase from the previous year. The sector's export-to-import ratio stood at 92.8%, surpassing the national average and demonstrating the industry's capacity to boost exports while managing imports effectively. Ventilation systems and components grew by 16.6% year-on-year, while the air conditioning sub-sector grew by 11.3%, and the heating and cooling sub-sectors increased by 7.9% and 3.9%, respectively (Turkish HVAC&R Exporters Association, 2023). The kilogram unit price for exports also rose from \$5.2 in Q1 2022 to \$6.3 in Q1 2023, reflecting a global shift toward energy-efficient solutions that are evident in Turkey's production and adoption of such systems (Turkish HVAC&R Exporters Association, 2023). This alignment with global environmental and energy efficiency standards has enhanced Turkey's competitiveness in international markets, marking a transition towards higher-value and innovative products.

The research question for this study is driven by several factors, particularly the highly competitive nature of the Turkish HVAC market. A scientific evaluation of core competencies within this market can reveal unique strengths that are deemed critical for achieving differentiation and maintaining competitiveness. Wernerfelt (1984) emphasized that leveraging these competencies enables firms to strategically allocate resources, thereby enhancing both operational efficiency and customer satisfaction. When effectively utilized and combined, these strategic resources evolve into core competencies, enabling firms to coordinate their skills and capabilities more effectively. According to Prahalad and Hamel (1990), core competencies facilitate the integration of diverse technologies and skills, forming the foundation of sustainable competitive advantage.

Numerous studies highlight the importance of core competencies across various industries, emphasizing their role in securing a competitive edge. For instance, research in the automotive sector underscores the significance of core competencies in fostering innovation, improving operational efficiency as well as ensuring long-term sustainability (Dosi et al., 2000; Kak & Sushil, 2002; Kolk & Pinkse, 2004). In the HVAC sector, such a strategic focus is essential for developing energy-efficient products, adopting advanced technologies and optimizing supply chains—all of which are necessary to maintain a competitive edge (Kolk & Pinkse, 2004). With evolving energy regulations and increasing consumer demand for environmentally friendly products, the urgency for sustainable solutions in the HVAC sector has never been greater (International Energy Agency, 2020). Core competencies play a central role in advancing environmental sustainability, making their exploration within the HVAC industry essential for guiding eco-conscious business practices.

In the HVAC sector, firms that possess proprietary energy-efficient technologies or AI-integrated systems exemplify the valuable, rare, inimitable, and non-substitutable resources, described by Barney (1991) as critical for achieving and sustaining a competitive advantage. Identifying and understanding core competencies in the HVAC industry is also vital for firms aiming to enhance their strategic positioning, operational efficiency, and responsiveness to market changes. This focus on core competencies is particularly relevant in the dynamic global and Turkish markets, where energy efficiency and sustainability are increasingly prioritized.

Although substantial research exists on core competencies across various industries, the air conditioning sector—characterized by its emphasis on technological innovation, adherence to global standards, and commitment to sustainability—has not received comparable academic attention. Addressing this gap, this study seeks to provide valuable insights into the competitive capabilities of the HVAC industry and contribute meaningfully to academic discourse. Additionally, in a sector as volatile as HVAC, where technological and regulatory landscapes are constantly evolving, adaptability is crucial for long-term success. Understanding and enhancing core competencies within this sector is essential not only for achieving immediate competitive advantages but also for ensuring sustained success in an increasingly competitive and environmentally conscious global market.

Despite substantial research on core competencies across various industries, the HVAC sector—characterized by its emphasis on technological innovation, adherence to global standards, and commitment to sustainability—remains underexplored in terms of the organizational capabilities required for sustained success. This study aims to bridge this gap by investigating the functionally based core competencies that enable firms to adapt to the rapidly evolving HVAC landscape. The research focuses on a leading Turkish HVAC firm to provide a unique perspective on how firms in emerging economies navigate the complex interplay between technological innovation, regulatory compliance, and customer-oriented strategies. By addressing this underexplored area, the study not

only enhances academic understanding of organizational competencies within the HVAC sector but also offers practical insights for industry stakeholders seeking to achieve long-term competitiveness and sustainability.

3. Research Objectives, Methodology and Data

The study aims to explore and identify the essential functionally based core competencies required for firms in the HVAC sector to sustain performance and competitiveness amid evolving market conditions. The research is based on a case study of a leading Turkish HVAC company, noted for its sustainable performance indicators and practices. This firm was selected due to its significant market share, export volume, and a comprehensive distribution network both within Turkey and internationally.

In evaluating core competencies within the HVAC sector, the research considers various methodological approaches detailed in the literature. While case studies offer in-depth insights into firm-specific strategies, they often lack broader applicability. On the other hand, quantitative analyses, such as those demonstrated by Schilke (2014), identify patterns across larger samples but may overlook contextual nuances. Mixed-method approaches, which combine qualitative and quantitative techniques, have been particularly effective in capturing the breadth and depth of core competency studies (Creswell & Plano Clark, 2017). Additionally, while the literature primarily employs quantitative methods for identifying core competencies in firms, there is now a broader understanding that these competencies include collective learning, skill coordination, management, technical expertise, and experience, leading to varied perceptions across similar sectors (Gilgeous & Parveen, 2001). However, there is a recognized need for better tools to evaluate functional capabilities, which this study addresses by using both qualitative and quantitative methods. This mixed-method approach capitalizes on the strengths of both methodologies to provide a comprehensive understanding of core competencies in the Turkish HVAC sector.

To operationalize this approach, the 'Core Competency Analysis Form' was developed through a systematic, five-stage process guided by qualitative research methods. In the first stage, a pool of variables was created based on existing literature (e.g., Fidanboy, 2016; Hafeez et al., 2002) as well as sector-related reports. Next, a focus group study was conducted with a senior executive from a different company operating in the same sector, during which each statement in the question pool was meticulously reviewed. In the third stage, the statements for each function were refined to ensure conciseness and clarity. Finally, in the fourth stage, consultations with three academic experts and a senior executive from another firm in the same sector ensured the reliability and validity of the form. Their feedback on the form's clarity and comprehensibility was incorporated into the final version. The participants involved in the qualitative phase consisted of two individuals with extensive sectoral experience who had held senior management positions for many years. The academic experts, on the other hand, possessed advanced academic qualifications in the field of strategic management. These individuals were purposefully selected to ensure the expertise and relevance required for the study. Purposive sampling was chosen to ensure the selection of participants with relevant expertise and experience, thereby enhancing the quality and applicability of the insights gathered for the study. The focus group study and consultations were conducted face-to-face, with an average duration of 165 minutes.

As part of the quantitative research, 25 participants from different functional areas, including marketing, production, R&D, and supply chain management, evaluated their firm's performance over the past five years using the Core Competency Analysis Form. Participants assessed their firm's performance over the past five years using the DEMATEL method, which is known for analyzing cause-and-effect relationships among criteria. This method proved particularly effective for identifying functional-level core competencies and their impact on performance. Data for this study was sourced from Boroomand's (2019) unpublished thesis, "Determining core competencies in sustainable competitive advantage by DEMATEL method: A case study in the air conditioning sector," supervised by Assoc. Prof. Ayşe Eren (Durmuş)-Özdemir.

4. Results

The DEMATEL technique was utilized to identify the firm's function-based core competencies and the factors influencing overall organizational performance. The DEMATEL steps were applied individually to each function. Participants assessed the importance of competencies based on performance over the past five years, using a scale from 1 (Not very important) to 5 (Very important). Competencies with an average score above 3 were classified as critical. Based on the results from the DEMATEL analysis, several critical functional competencies in the HVAC firm were identified, considering their mean scores:

Marketing and Sales Function: High mean scores were observed for recognizing customer demands (A01: 4.4) and adapting to competition (A02: 4.2). These competencies are vital for maintaining market competitiveness. Additionally, the ability to provide goods and services that align with customer needs (A04: 3.2) and to diversify offerings (A10: 4.4) underscore the importance of customer-centric strategies in sustaining a competitive edge.

Production and Quality Function: Competencies such as increasing production quality (B05: 4.6) and managing production processes effectively (B01: 4.3, B02: 4.3) are crucial for the firm. The ability to reduce production costs while maintaining quality (B20: 5.0) emerges as a significant strength, reinforcing the firm's competitive position.

R&D Function: Key competencies include technology adaptation (C02: 4.7) and the development of new products (C03: 4.7, C08: 4.7). Strategic planning for R&D (C13: 4.5) is also critical, highlighting the importance of innovation and responsiveness to market demands.

Human Resources Function: Improving employee skills through training (E01: 4.5) and applying performance-based compensation (E03: 4.5, E04: 4.5) are essential for maintaining a productive workforce. Attracting and retaining qualified staff (E06: 3.5) are also crucial for long-term competitiveness.

Performance and Planning Function: Encouraging teamwork (F08: 4.5) and designing an effective organizational structure (F09: 3.3) are crucial for enhancing overall performance. Integrating efficiency into the organizational culture (F04: 3.3) reflects the firm's commitment to operational excellence.

Information Technology Function: Ensuring data security (G02: 4.5) and leveraging information technologies to increase efficiency (G07: 4.5, G08: 4.5) are key to supporting the firm's operational resilience and agility in a dynamic technological landscape.

These findings highlight the critical competencies across various functions that are essential for maintaining the firm's competitive advantage and ensuring sustainable performance. The most critical competency across all functions is B20 ("Reducing production cost as competition in the current sector increases") with a mean score of 5.0, indicating its paramount importance. On the other hand, F10 ("Defining and developing effective leadership that will enhance performance") is among the lowest-rated, with a score of 3.1, highlighting a need for improvement in leadership development. The DEMATEL analysis has identified the core competencies that are most critical to influencing performance at the company level (Table 1).

Table 1. The Firm's Core Competencies

The Codes	Functions	Critical Competence
A01	Marketing and Sales	Identifying goods and services in line with customer demands to quickly respond to international and national competition
B08	Production and Quality	Working more efficiently through flexible production
C03	R&D	Developing innovative goods or services
D13	Supply Chain and Logistics	Improving the supply chain system to respond quickly to unexpected customer demands
E06	HR	Hiring qualified, expert, and talented staff
F09	Performance and Planning	Designing an effective organizational structure to enhance performance
G02	IT	Ensuring information and data security across all units of the business

Figure 1 illustrates the cause-effect relationships among criteria as determined in the final step of the DEMATEL analysis, using the calculated (R+D, R-D) values. A threshold ($\alpha = 0.2$) was established to distinguish influencing criteria (those above the threshold) from influenced criteria (those below), leading to the development of the "Coordinate Planes of Influencing and Influenced Criteria." Criteria above this threshold are classified as "influencing," while those below are categorized as "influenced." The analysis identifies A, F, E, and G as influencing criteria, whereas B, C, and D are classified as influenced. Criterion C, with the most negative value (R-D = -1.415), is the most affected, primarily by all other criteria, followed by B (R-D = -0.761) and D (R-D = -0.877), which are less affected. In contrast, within the influencing group, criterion E shows a moderate impact (R-D = 0.534), while criteria G (R-D = 0.678) and F (R-D = 0.882) exhibit stronger influences.

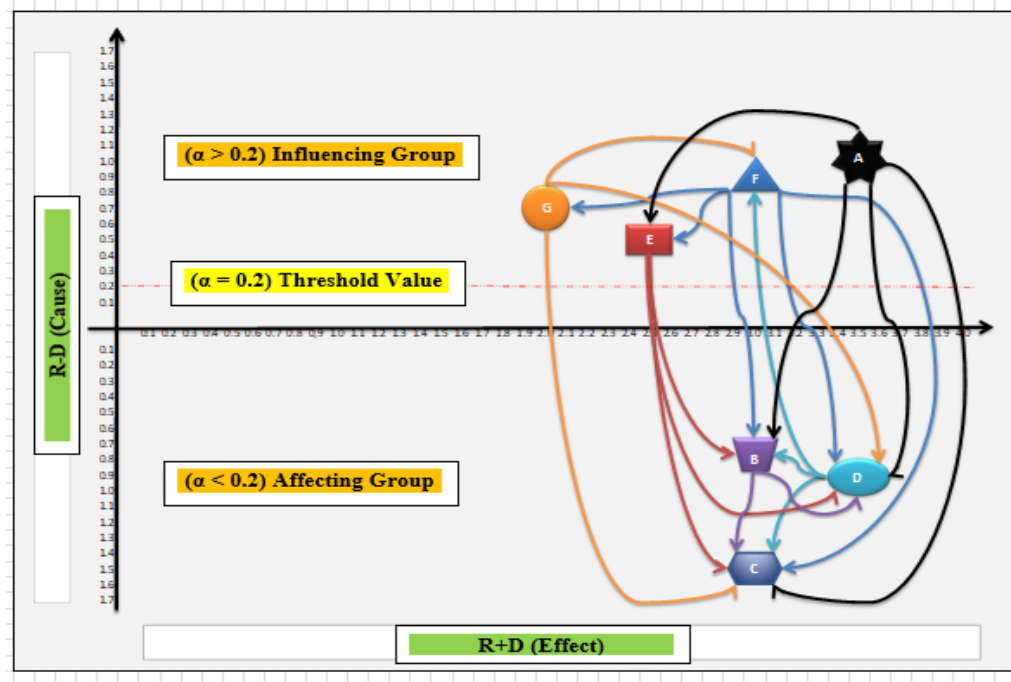


Fig. 1. Cause-Effect Graph Between Criteria
Source: Author's Calculations

Among all influencing criteria, A stands out with the highest value (R-D = 0.960), marking it as the most significant influencer. Therefore, criterion A exerts the strongest effect on the system, playing a crucial role in the achievement of operational goals and objectives.

5. Conclusions

This study conclusively demonstrates the critical importance of functionally based core competencies in sustaining performance and ensuring competitiveness within the HVAC sector. Grounded in a comprehensive case study of a leading Turkish HVAC company, the DEMATEL method was applied in this research to identify and analyze the firm's key competencies across various functional areas. Among the most critical competencies identified is the ability to swiftly adapt to competitive pressures, particularly through a strong focus on customer-oriented products within marketing and sales. This focus is not merely strategic. It represents an ongoing process that requires cross-functional collaboration and active employee engagement. These elements ensure organizational alignment with customer needs. In literature, the significance of core competencies in achieving competitive advantage has been extensively emphasized through pioneering studies (Kumar et al., 2011; Lieberman & Montgomery, 1998; Pelham, 1997). These studies have detailed how core competencies evolve into strategic tools for maintaining and enhancing a firm's competitive position. Furthermore, a customer-oriented marketing strategy, encompassing market segmentation, differentiation, and

positioning, proves essential for creating unique value propositions that resonate with target customers (Talpa, & Boscor, 2011).

The study's contributions are multifaceted. First, it provides empirical evidence on the critical functionally based competencies required for firms in the HVAC sector to thrive in a dynamic and competitive environment. The use of the DEMATEL method offers a robust analytical framework for identifying and prioritizing these competencies, thus contributing to both academic knowledge and practical applications in strategic management. Additionally, the study addresses the gap in the literature concerning core competencies in the HVAC sector, which has not received the same level of attention as other industries, such as automotive or technology. Valuable insights that can guide future research and practice in similar industrial contexts are offered through a sector-specific analysis.

The novelty of this research lies in its application of the DEMATEL method to the HVAC sector, a methodological approach that has not been extensively explored in previous studies. By systematically identifying and prioritizing functionally based core competencies, this study provides a unique framework for understanding the interdependencies among these competencies and their impact on firm performance and competitiveness. Unlike prior research, which has largely focused on technological advancements, energy efficiency, and product innovation (Pérez-Lombard et al., 2008), the focus is shifted to the organizational competencies that enable firms to navigate the complex and dynamic HVAC market. A significant finding is the critical role of customer-oriented strategies, particularly in marketing and sales, as drivers of sustainable competitive advantage. These competencies are not merely operational but strategic, requiring cross-functional collaboration and active alignment with customer needs—a perspective underexplored in existing literature (Kohli & Jaworski, 1990; Prahalad & Hamel, 1990). This emphasis on organizational capabilities broadens the scope of research in the HVAC sector and fills a critical gap by highlighting the interplay between technological advancements and functional competencies.

The implications of this research are multifaceted, with significant contributions to both academic and practical domains. A robust framework for analyzing core competencies in an underrepresented industry within strategic management literature is provided by the study. By extending the application of dynamic capabilities theory (Teece et al., 1997) to the HVAC sector, it underscores the importance of integrating, building, and reconfiguring organizational competencies to address rapid market and regulatory changes. Practically, the findings offer actionable insights for industry practitioners, particularly in emerging economies, on how to leverage customer-oriented and sustainability-driven strategies to maintain a competitive edge. For instance, the study highlights the importance of investments in cross-functional employee engagement and advanced training programs to enhance organizational alignment and adaptability, echoing findings from the broader management literature (Eden & Ackermann, 2010; Nobre, 2011). Furthermore, the focus on sustainability and energy efficiency aligns with global trends, providing firms with a strategic pathway to meet regulatory requirements while addressing consumer demands for environmentally friendly solutions. By identifying the core competencies essential for long-term success, this research equips firms in the HVAC sector with the tools to thrive in an increasingly volatile and competitive landscape.

However, the study is not without limitations. The data was collected from a single company within the HVAC sector, which may limit the generalizability of the findings. While the results offer in-depth insights into the specific context of the studied company, broader studies encompassing multiple firms across various regions and sub-sectors are essential to validate and extend these findings. A more diverse and representative sample should be included in future research to enhance the external validity of the conclusions. Additionally, it is recommended that future studies incorporate sectoral differentiation to refine the core competency analysis, making it more applicable across various industrial contexts.

In comparison to other research in related fields, such as the automotive sector, where core competencies have been identified as drivers of innovation and long-term sustainability, this study emphasizes similar themes within the HVAC industry. The findings corroborate the notion that core competencies are not only central to maintaining competitive advantage but also critical for navigating the challenges posed by rapid technological and regulatory changes (Eden & Ackermann, 2010; Nobre, 2011; Tan & Sousa, 2015). The results suggest that the HVAC sector, much like other industries, must focus on developing flexible, knowledge-based, and environmentally sustainable

competencies to stay competitive in the long term. Moreover, the study provides a solid foundation for understanding how core competencies impact firm performance and competitiveness within the HVAC sector. The results have significant implications for both academia and industry practitioners, offering a framework for identifying and leveraging core competencies in strategic decision-making. These competencies, when properly understood and nurtured, can provide the foundation for sustained competitive advantage in increasingly volatile markets.

In conclusion, this study contributes significantly to the understanding of core competencies in the HVAC sector by offering a detailed analysis of their impact on firm performance and competitiveness. The findings highlight the importance of these competencies in sustaining a competitive edge and suggest that further research should explore their evolution over time through longitudinal studies. Additionally, there is a need to examine the interplay between core competencies and dynamic capabilities, as this would provide deeper insights into how firms can sustain competitive advantage in an environment characterized by rapid technological advancements and shifting regulatory environment. Future research should also aim to replicate this study across different sectors and regions to validate its findings and expand its applicability. This comprehensive examination not only enhances our understanding of core competencies within the HVAC sector but also underscores the broader relevance of these competencies across industries. The insights generated by this study are invaluable in terms of both theory and practice, offering a clear path forward for firms seeking to maintain their competitive advantage in an increasingly challenging business environment.

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